Storm Water Management Plan
For Priority Projects
(Major SWMP)

Project Name	TPM 21086
Permit Number (Land Development Projects):	TPM 21086, Env. Log # 07-09-008
Work Authorization Number (CIP):	
Applicant:	MLB Engineering
Applicant's Address:	404 South Live Oak Park Road Fallbrook, CA 92028
Plan Prepared By: *(Leave blank if same as applicant)*	
Date:	~~07/17/2008~~ 7/21/2009
Revision Date(If applicable):	

The County of San Diego Watershed Protection, Storm Water Management, and Discharge Control Ordinance (WPO) (Ordinance No. 9926) requires all applications for a permit or approval associated with a Land Disturbance Activity must be accompanied by a Storm Water Management Plan (SWMP) (section 67.806.b). The purpose of the SWMP is to describe how the project will minimize the short and long-term impacts on receiving water quality. Projects that meet the criteria for a priority project are required to prepare a Major SWMP.

Since the SWMP is a living document, revisions may be necessary during various stages of approval by the County. Please provide the approval information requested below.

Project Review Stage	Does the SWMP need revisions?		If YES, Provide Revision Date
	YES	NO	

Completion of the following checklist and attachments will fulfill the requirements of a Major SWMP for the project listed above.

PROJECT DESCRIPTION

Project Location:

The site is located in the Valley Center area of the unincorporated territory of the County of San Diego, CA. TPM 21086 is on the south side of a private road known as Via Salvador approximately 1100 feet easterly of Mac Tan Road.

Project Description:

The project site is a vacant 4.4 acre. The proposed project will subdivide the property into two residential parcels. Construction will include limited street and utility improvements along Via Salvador, as well as on-site grading to create building pads. The amount of anticipated grading is approximately 900 cubic yards.

Topography:

The surface of the site has an average slope of about 10 percent, down from the north to the south. A well defined natural drainage channel starts near the north end of the site and continues across the site to the south property line. There are a few scattered trees, but most of the site is covered with sparse low lying brush and grasses.

Surrounding Land Use:

The site is adjacent to single family homes on minimum 2 acre parcels to the east, west & south. There are also groves to the east and west and an agricultural use north of Via Salvador adjoining the property. There is one vacant property adjoining the site on the southwest. The surrounding properties are zoned for residential-agricultural use as is the site.

Proposed Project Land Use:

The proposed land use is the same as the surrounding properties, residential on parcels of a minimum 2 acres in size.

Location of Dry Weather Flows:

There did not appear to be any evidence of dry weather flows in the site during multiple site visits.

PRIORITY PROJECT DETERMINATION

Please check the box that best describes the project. Does the project meet one of the following criteria?

Table 1

PRIORITY PROJECT	YES	NO
Redevelopment that creates or adds at least 5,000 net square feet of additional impervious surface area.		✓
Residential development of more than 10 units.		✓
Commercial developments with a land area for development of greater than 1 acre.		✓
Automotive repair shops.		✓
Restaurants, where the land area for development is greater than 5.000 square Feet.		✓
Hillside development, in an area with known erosive soil conditions, where there will be grading on any natural slope that is twenty-five percent or greater, if the development creates 5,000 square feet or more of impervious surface.		✓
Environmentally Sensitive Areas (ESA): All development located within or directly adjacent to or discharging directly to an ESA (where discharges from the development or redevelopment will enter receiving waters within the ESA), which either creates 2,500 square feet of impervious surface on a proposed project site or increases the area of imperviousness of a proposed project site to 10% or more of its naturally occurring condition. “Directly adjacent” means situated within 200 feet of the ESA. “Discharging directly to” means outflow from a drainage conveyance system that is composed entirely of flows from the subject development or redevelopment site, and not commingled with flows from adjacent lands		✓
Parking Lots 5,000 square feet or more or with 15 parking spaces or more and potentially exposed to urban runoff.		✓
Streets, roads, highways, and freeways which would create a new paved surface that is 5,000 square feet or greater.	✓	
Retail Gasoline Outlets (RGO) that meet the following criteria: (a) 5,000 square feet or more or (b) a projected Average Daily Traffic (ADT) of 100 or more vehicles per day.		✓

Limited Exclusion: Trenching and resurfacing work associated with utility projects are not considered priority projects. Parking lots, buildings and other structures associated with utility projects are subject to SUSMP requirements if one or more of the criteria above are met.

If you answered **NO** to all the questions, then **STOP.** Please complete a Minor SWMP for your project.

If you answered **YES** to any of the questions, please continue.

HYDROMODIFICATION DETERMINATION
The following questions provide a guide to collecting information relevant to hydromodification management issues.

Table 2

	QUESTIONS	**YES**	**NO**	**Information**
1.	Will the proposed project disturb 50 or more acres of land? (Including all phases of development)		✓	If YES, continue to 2. If NO, go to 6.
2.	Would the project site discharge directly into channels that are concrete-lined or significantly hardened such as with riprap, sackcrete, etc, downstream to their outfall into bays or the ocean?			If NO, continue to 3. If YES, go to 6.
3.	Would the project site discharge directly into underground storm drains discharging directly to bays or the ocean?			If NO, continue to 4. If YES, go to 6.
4.	Would the project site discharge directly to a channel (lined or un-lined) and the combined impervious surfaces downstream from the project site to discharge at the ocean or bay are 70% or greater?			If NO, continue to 5. If YES, go to 6.
5.	Project is required to manage hydromodification impacts.			Hydromodification Management Required as described in Section 67.812 b(4) of the WPO.
6.	Project is not required to manage hydromodification impacts.			Hydromodification Exempt. Keep on file.

An exemption is potentially available for projects that are required (No. 5. in Table 2 above) to manage hydromodification impacts: The project proponent may conduct an independent geomorphic study to determine the project's full hydromodification impact. The study must incorporate sediment transport modeling across the range of geomorphically-significant flows and demonstrate to the County's satisfaction that the project flows and sediment reductions will not detrimentally affect the receiving water to qualify for the exemption.

STORMWATER QUALITY DETERMINATION

The following questions provide a guide to collecting information relevant to project stormwater quality issues. Please provide the following information in a printed report accompanying this form.

Table 3

	QUESTIONS	COMPLETED	NA
1.	Describe the topography of the project area.	✓	
2.	Describe the local land use within the project area and adjacent areas.	✓	
3.	Evaluate the presence of dry weather flow.	✓	
4.	Determine the receiving waters that may be affected by the project throughout the project life cycle (i.e., construction, maintenance and operation).	✓	
5.	For the project limits, list the 303(d) impaired receiving water bodies and their constituents of concern.	✓	
6.	Determine if there are any High Risk Areas (municipal or domestic water supply reservoirs or groundwater percolation facilities) within the project limits.	✓	
7.	Determine the Regional Board special requirements, including TMDLs, effluent limits, etc.	✓	
8.	Determine the general climate of the project area. Identify annual rainfall and rainfall intensity curves.	✓	
9.	If considering Treatment BMPs, determine the soil classification, permeability, erodibility, and depth to groundwater.	✓	
10.	Determine contaminated or hazardous soils within the project area.	✓	
11.	Determine if this project is within the environmentally sensitive areas as defined on the maps in Appendix A of the *County of San Diego Standard Urban Storm Water Mitigation Plan for Land Development and Public Improvement Projects.*	✓	
12.	Determine if this is an emergency project.	✓	

STORMWATER QUALITY DETERMINATION REPORT

1. Topography:
The surface of the site has an average slope of about 10 percent, down from the north to the south. A well defined natural drainage channel starts near the north end of the site and continues across the site to the south property line. There are a few scattered trees, but most of the site is covered with sparse low lying brush and grasses.

2. Land Use:
The site is vacant and situated adjacent to single family homes on minimum 2 acre parcels to the east, west & south. There are also groves to the east and west and an agricultural use north of Via Salvador adjoining the property. There is one vacant property adjoining the site on the southwest. The surrounding properties are zoned for residential-agricultural use as is the site.

3. Dry Weather Flows:
There did not appear to be any evidence of dry weather flows in the site during multiple site visits.

4. Receiving Waters:
The project is located in the Lower San Luis Rey Hydraulic Area (903.12) of the San Luis Rey Hydrologic Unit. The storm water runoff from the site drains overland in natural drainage channels to the San Luis Rey River, and then the Pacific Ocean.

5. 303(d) Impairments:
There are no 303(d) impairments listed within the project limits.

6. High Risk Areas:
There are no municipal or domestic water supply reservoirs within the project limits.

7. Regional Board Special Requirements:
There are no listed TDMLs, effluent limits, or other special requirements within the project limits.

8. Annual Rainfall:
This area has an annual average rainfall of 16 inches. The 100 year 6-hr. rainfall is 3.8 inches.

9. Soils Classification:
Soil type on-site is Group C. There are no significant signs of erosion on-site. Ground water depth is unknown, but was not encountered in 15 foot borings.

10. Contaminated or Hazardous Soils:
There are no known contaminated or hazardous soils within the project area.

11. Environmentally Sensitive Areas:
This project is not within the environmentally sensitive areas as defined on the maps in Appendix A.

12. Emergency Project:
This is not an emergency project.

WATERSHED

Please check the watershed(s) for the project.

	San Juan		Santa Margarita	X	San Luis Rey		Carlsbad
	San Dieguito		Penasquitos		San Diego		Pueblo San Diego
	Sweetwater		Otay		Tijuana		

Please provide the hydrologic sub-area and number(s)

Number	Name
903.16	Rincon

Please provide the beneficial uses for Inland Surface Waters and Ground Waters.

SURFACE WATERS	**Hydrologic Unit Basin Number**	MUN	AGR	IND	PROC	GWR	FRSH	POW	REC1	REC2	BIOL	WARM	COLD	WILD	RARE	SPWN
Inland Surface Waters																
Unnamed intermittent streams	903.16	*	X	X				X	X			X		X		
Ground Waters																
Lower San Luis	903.10	X	X	X												

X Existing Beneficial
0 Potential Beneficial Use
* Excepted from Municipal

POLLUTANTS OF CONCERN

Using Table 1, identify pollutants that are anticipated to be generated from the proposed priority project categories. Pollutants associated with any hazardous material sites that have been remediated or are not threatened by the proposed project are not considered a pollutant of concern.

Table 1. Anticipated and Potential Pollutants Generated by Land Use Type

	General Pollutant Categories								
Priority Project Categories	Sediments	Nutrients	Heavy Metals	Organic Compounds	Trash & Debris	Oxygen Demanding Substances	Oil & Grease	Bacteria & Viruses	Pesticides
Detached Residential Development	X	X			X	X	X	X	X
Attached Residential Development	X	X			X	P(1)	P(2)	P	X
Commercial Development >100,000 ft2	P(1)	P(1)		P(2)	X	P(5)	X	P(3)	P(5)
Automotive Repair Shops			X	X(4)(5)	X		X		
Restaurants					X	X	X	X	
Hillside Development >5,000 ft2	X	X			X	X	X		X
Parking Lots	P(1)	P(1)	X		X	P(1)	X		P(1)
Streets, Highways & Freeways	X	P(1)	X	X(4)	X	P(5)	X		

X = anticipated
P = potential
(1) A potential pollutant if landscaping exists on-site.
(2) A potential pollutant if the project includes uncovered parking areas.
(3) A potential pollutant if land use involves food or animal waste products.
(4) Including petroleum hydrocarbons.
(5) Including solvents.

Note: If other monitoring data that is relevant to the project is available. Please include as Attachment C.

CONSTRUCTION BMPs

Please check the construction BMPs that may be used. The BMPs selected are those that will be implemented during construction of the project. The applicant is responsible for the placement and maintenance of the BMPs selected.

X	Silt Fence		Desilting Basin
X	Fiber Rolls	X	Gravel Bag Berm
X	Street Sweeping and Vacuuming	X	Sandbag Barrier
	Storm Drain Inlet Protection	X	Material Delivery and Storage
X	Stockpile Management	X	Spill Prevention and Control
X	Solid Waste Management	X	Concrete Waste Management
X	Stabilized Construction Entrance/Exit	X	Water Conservation Practices
X	Dewatering Operations	X	Paving and Grinding Operations
	Vehicle and Equipment Maintenance		
X	Any minor slopes created incidental to construction and not subject to a major or minor grading permit shall be protected by covering with plastic or tarp prior to a rain event, and shall have vegetative cover reestablished within 180 days of completion of the slope and prior to final building approval.		

EXCEPTIONAL THREAT TO WATER QUALITY DETERMINATION
Complete the checklist below to determine if a proposed project will pose an "exceptional threat to water quality," and therefore require Advanced Treatment Best Management Practices.

Table 6

No.	CRITERIA	YES	NO	INFORMATION
1.	Is all or part of the proposed project site within 200 feet of waters named on the Clean Water Act (CWA) Section 303(d) list of Water Quality Limited Segments as impaired for sedimentation and/or turbidity?		✓	If YES, continue to 2. If NO, go to 5.
2.	Will the project disturb more than 5 acres, including all phases of the development?			If YES, continue to 3. If NO, go to 5.
3.	Will the project disturb slopes that are steeper than 4:1 (horizontal:vertical) with at least 10 feet of relief, and that drain toward the 303(d) listed receiving water for sedimentation and/or turbidity?			If YES, continue to 4. If NO, go to 5.
4.	Will the project disturb soils with a predominance of USDA-NRCS Erosion factors kf greater than or equal to 0.4?			If YES, continue to 6. If NO, go to 5.
5.	Project is not required to use Advanced Treatment BMPs.			Document for Project Files by referencing this checklist.
6.	Project poses an "exceptional threat to water quality" and is required to use Advanced Treatment BMPs.			Advanced Treatment BMPs must be consistent with WPO section 67.811(b)(20)(D) performance criteria

Exemption potentially available for projects that require advanced treatment:
Project proponent may perform a Revised Universal Soil Loss Equation, Version 2 (RUSLE 2), Modified Universal Soil Loss Equation (MUSLE), or similar analysis that shows to the County official's satisfaction that advanced treatment is not required Now that the need for treatment BMPs has been determined, other information is needed to complete the SWMP.

SITE DESIGN

To minimize stormwater impacts, site design measures must be addressed. The following checklist provides options for avoiding or reducing potential impacts during project planning. If YES is checked, it is assumed that the measure was used for this project.

Table 7

	OPTIONS		YES	NO	N/A
1.	Has the project been located and road improvements aligned to avoid or minimize impacts to receiving waters or to increase the preservation of critical (or problematic) areas such as floodplains, steep slopes, wetlands, and areas with erosive or unstable soil conditions?		✓		
2.	Is the project designed to minimize impervious footprint?		✓		
3.	Is the project conserving natural areas where feasible?		✓		
4.	Where landscape is proposed, are rooftops, impervious sidewalks, walkways, trails and patios be drained into adjacent landscaping?		✓		
5.	For roadway projects, are structures and bridges designed or located to reduce work in live streams and minimize construction impacts?				✓
6.	Can any of the following methods be utilized to minimize erosion from slopes:				
	6.a.	Disturbing existing slopes only when necessary?	✓		
	6.b.	Minimize cut and fill areas to reduce slope lengths?	✓		
	6.c.	Incorporating retaining walls to reduce steepness of slopes or to shorten slopes?	✓		
	6.d.	Providing benches or terraces on high cut and fill slopes to reduce concentration of flows?	✓		
	6.e.	Rounding and shaping slopes to reduce concentrated flow?	✓		
	6.f.	Collecting concentrated flows in stabilized drains and channels?	✓		

LOW IMPACT DEVELOPMENT (LID)
Each numbered item below is a LID requirement of the WPO. Please check the box(s) under each number that best describes the Low Impact Development BMP(s) selected for this project.

Table 8

1. Conserve natural Areas, Soils, and Vegetation-County LID Handbook 2.2.1	
✓	Preserve well draining soils (Type A or B).
✓	Preserve Significant Trees.
	Other. Description:
	1. Not feasible. State Reason:
2. Minimize Disturbance to Natural Drainages-County LID Handbook 2.2.2	
✓	Set-back development envelope from drainages.
NA	Restrict heavy construction equipment access to planned green/open space areas.
	Other. Description:
	2. Not feasible. State Reason:
3. Minimize and Disconnect Impervious Surfaces (see 5) -County LID Handbook 2.2.3	
NA	Clustered Lot Design.
✓	Items checked in 5?
	Other. Description:
	3. Not feasible. State Reason:
4. Minimize Soil Compaction-County LID Handbook 2.2.4	
NA	Restrict heavy construction equipment access to planned green/open space areas.
✓	Re-till soils compacted by construction vehicles/equipment.
✓	Collect & re-use upper soil layers of development site containing organic materials.
	Other. Description:
	4. Not feasible. State Reason:
5. Drain Runoff from Impervious Surfaces to Pervious Areas-County LID Handbook 2.2.5	
LID Street & Road Design	
✓	Curb-cuts to landscaping
✓	Rural Swales
	Concave Median
	Cul-de-sac Landscaping Design
	Other. Description:

LID Parking Lot Design	
NA	Permeable Pavements
NA	Curb-cuts to landscaping
	Other. Description:
LID Driveway, Sidewalk, Bike-path Design	
	Permeable Pavements
✓	Pitch pavements toward landscaping
	Other. Description:
LID Building Design	
	Cisterns & Rain Barrels
✓	Downspout to swale
	Vegetated Roofs
	Other. Description:
LID Landscaping Design	
	Soil Amendments
✓	Reuse of Native Soils
✓	Smart Irrigation Systems
	Street Trees
	Other. Description:
	5. Not feasible. State Reason:

CHANNELS & DRAINAGES

Complete the following checklist to determine if the project includes work in channels.

Table 9

No.	CRITERIA	YES	NO	N/A	COMMENTS
1.	Will the project include work in channels?		✓		If YES go to 2 If NO go to 13.
2.	Will the project increase velocity or volume of downstream flow?				If YES go to 6.
3.	Will the project discharge to unlined channels?				If YES go to 6.
4.	Will the project increase potential sediment load of downstream flow?				If YES go to 6.
5.	Will the project encroach, cross, realign, or cause other hydraulic changes to a stream that may affect downstream channel stability?				If YES go to 8.
6.	Review channel lining materials and design for stream bank erosion.				Continue to 7.
7.	Consider channel erosion control measures within the project limits as well as downstream. Consider scour velocity.				Continue to 8.
8.	Include, where appropriate, energy dissipation devices at culverts.				Continue to 9.
9.	Ensure all transitions between culvert outlets/headwalls/wingwalls and channels are smooth to reduce turbulence and scour.				Continue to 10.
10.	Include, if appropriate, detention facilities to reduce peak discharges.				Continue to 11.
11.	“Hardening“ natural downstream areas to prevent erosion is not an acceptable technique for protecting channel slopes, unless pre-development conditions are determined to be so erosive that hardening would be required even in the absence of the proposed development.				Continue to 12.
12.	Provide other design principles that are comparable and equally effective.				Continue to 12.
13.	End				

SOURCE CONTROL

Please complete the following checklist for Source Control BMPs. If the BMP is not applicable for this project, then check N/A only at the main category.

Table 10

	BMP		YES	NO	N/A
1.	**Provide Storm Drain System Stenciling and Signage**				✓
	1.a	All storm drain inlets and catch basins within the project area shall have a stencil or tile placed with prohibitive language (such as: "NO DUMPING-DRAINS TO _____") and/or graphical icons to discourage illegal dumping.			
	1.b	Signs and prohibitive language and/or graphical icons, which prohibit illegal dumping, must be posted at public access points along channels and creeks within the project area.			
2.	**Design Outdoors Material Storage Areas to Reduce Pollution Introduction**				✓
	2.a	This is a detached single-family residential project. Therefore, personal storage areas are exempt from this requirement.			
	2.b.	Hazardous materials with the potential to contaminate urban runoff shall either be: (1) placed in an enclosure such as, but not limited to, a cabinet, shed, or similar structure that prevents contact with runoff or spillage to the storm water conveyance system; or (2) protected by secondary containment structures such as berms, dikes, or curbs.			
	2.c.	The storage area shall be paved and sufficiently impervious to contain leaks and spills.			
	2.d.	The storage area shall have a roof or awning to minimize direct precipitation within the secondary containment area.			
3.	**Design Trash Storage Areas to Reduce Pollution Introduction**				✓
	3.a.	Paved with an impervious surface, designed not to allow run-on from adjoining areas, screened or walled to prevent off-site transport of trash; or,			
	3.b.	Provide attached lids on all trash containers that exclude rain, or roof or awning to minimize direct precipitation.			
4.	**Use Efficient Irrigation Systems & Landscape Design**				
	The following methods to reduce excessive irrigation runoff shall be considered, and incorporated and implemented where determined applicable and feasible.				
	4.a.	Employing rain shutoff devices to prevent irrigation after precipitation.	✓		
	4.b.	Designing irrigation systems to each landscape area's specific water requirements.	✓		
	4.c.	Using flow reducers or shutoff valves triggered by a pressure drop to control water loss in the event of broken sprinkler heads or lines.	✓		
	4.d.	Employing other comparable, equally effective, methods to reduce irrigation water runoff.	✓		
5.	**Private Roads**				
	The design of private roadway drainage shall use at least one of the following				
	5.a.	Rural swale system: street sheet flows to vegetated swale or gravel shoulder, curbs at street corners, culverts under driveways and street crossings.	✓		
	5.b.	Urban curb/swale system: street slopes to curb, periodic swale inlets drain to vegetated swale/biofilter.	✓		
	5.c.	Dual drainage system: First flush captured in street catch basins and discharged to adjacent vegetated swale or gravel shoulder, high flows connect directly to storm water conveyance system.		✓	

	5.d.	Other methods that are comparable and equally effective within the project.		✓	
6.	**Residential Driveways & Guest Parking**				
	The design of driveways and private residential parking areas shall use one at least of the following features.				
	6.a.	Design driveways with shared access, flared (single lane at street) or wheelstrips (paving only under tires); or, drain into landscaping prior to discharging to the storm water conveyance system.	✓		
	6.b.	Uncovered temporary or guest parking on private residential lots may be: paved with a permeable surface; or, designed to drain into landscaping prior to discharging to the storm water conveyance system.	✓		
	6.c.	Other features which are comparable and equally effective.		✓	
7.	**Dock Areas**				✓
	Loading/unloading dock areas shall include the following.				
	7.a.	Cover loading dock areas, or design drainage to preclude urban run-on and runoff.			
	7.b.	Direct connections to storm drains from depressed loading docks (truck wells) are prohibited.			
	7.c.	Other features which are comparable and equally effective.			
8.	**Maintenance Bays**				✓
	Maintenance bays shall include the following.				
	8.a.	Repair/maintenance bays shall be indoors; or, designed to preclude urban run-on and runoff.			
	8.b.	Design a repair/maintenance bay drainage system to capture all wash water, leaks and spills. Connect drains to a sump for collection and disposal. Direct connection of the repair/maintenance bays to the storm drain system is prohibited. If required by local jurisdiction, obtain an Industrial Waste Discharge Permit.			
	8.c.	Other features which are comparable and equally effective.			
9.	**Vehicle Wash Areas**				✓
	Priority projects that include areas for washing/steam cleaning of vehicles shall use the following.				
	9.a.	Self-contained; or covered with a roof or overhang.			
	9.b.	Equipped with a clarifier or other pretreatment facility.			
	9.c.	Properly connected to a sanitary sewer.			
	9.d.	Other features which are comparable and equally effective.			
10.	**Outdoor Processing Areas**				✓
	Outdoor process equipment operations, such as rock grinding or crushing, painting or coating, grinding or sanding, degreasing or parts cleaning, waste piles, and wastewater and solid waste treatment and disposal, and other operations determined to be a potential threat to water quality by the County shall adhere to the following requirements.				
	10.a.	Cover or enclose areas that would be the most significant source of pollutants; or, slope the area toward a dead-end sump; or, discharge to the sanitary sewer system following appropriate treatment in accordance with conditions established by the applicable sewer agency.			
	10.b.	Grade or berm area to prevent run-on from surrounding areas.			

	10.c.	Installation of storm drains in areas of equipment repair is prohibited.			
	10.d.	Other features which are comparable or equally effective.			
11.	**Equipment Wash Areas**				✓
	Outdoor equipment/accessory washing and steam cleaning activities shall be.				
	11.a.	Be self-contained; or covered with a roof or overhang.			
	11.b.	Be equipped with a clarifier, grease trap or other pretreatment facility, as appropriate			
	11.c.	Be properly connected to a sanitary sewer.			
	11.d.	Other features which are comparable or equally effective.			
12.	**Parking Areas**				✓
	The following design concepts shall be considered, and incorporated and implemented where determined applicable and feasible by the County.				
	12.b.	Overflow parking (parking stalls provided in excess of the County's minimum parking requirements) may be constructed with permeable			
	12.c.	Other design concepts that are comparable and equally effective.			
13.	**Fueling Area**				✓
	Non-retail fuel dispensing areas shall contain the following.				
	13.a.	Overhanging roof structure or canopy. The cover's minimum dimensions must be equal to or greater than the area within the grade			
	13.b.	Paved with Portland cement concrete (or equivalent smooth impervious surface). The use of asphalt concrete shall be prohibited.			
	13.c.	Have an appropriate slope to prevent ponding, and must be separated from the rest of the site by a grade break that prevents run-on of urban			
	13.d.	At a minimum, the concrete fuel dispensing area must extend 6.5 feet (2.0 meters) from the corner of each fuel dispenser, or the length at			

Please list other project specific Source Control BMPs in the following box. Write **N/A** if there are none and briefly explain.

- Private road has been designed with the minimum allowable paved width as required by DPW and the Fire Marshal.

TREATMENT CONTROL

To select a structural treatment BMP using Treatment Control BMP Selection Matrix (Table 11), each priority project shall compare the list of pollutants for which the downstream receiving waters are impaired (if any), with the pollutants anticipated to be generated by the project (as identified in Table 5). Any pollutants identified by Table 1, which are also causing a Clean Water Act section 303(d) impairment of the receiving waters of the project, shall be considered primary pollutants of concern. Priority projects that are anticipated to generate a primary pollutant of concern shall select a single or combination of stormwater BMPs from Table 2, which **maximizes pollutant removal** for the particular primary pollutant(s) of concern.

Priority projects that are **not** anticipated to generate a pollutant for which the receiving water is Clean Water Act Section 303(d) impaired shall select a single or combination of stormwater BMPs from Table 11, which are effective for pollutant removal of the identified secondary pollutants of concern, consistent with the "maximum extent practicable" standard.

Table 11. Treatment Control BMP Selection Matrix

Pollutant of Concern	Bioretention Facilities (LID)*	Settling Basins (Dry Ponds)	Wet Ponds and Wetlands	Infiltration Facilities or Practices (LID)*	Media Filters	High-rate biofilters	High-rate media filters	Trash Racks & Hydrodynamic Devices
Coarse Sediment and Trash	High	High	High	High	High	High	High	High
Pollutants that tend to associate with fine particles during treatment	High	High	High	High	High	Medium	Medium	Low
Pollutants that tend to be dissolved following treatment	Medium	Low	Medium	High	Low	Low	Low	Low

*Additional information is available in the County of San Diego LID Handbook.

NOTES ON POLLUTANTS OF CONCERN:
In Table 12, Pollutants of Concern are grouped as gross pollutants, pollutants that tend to associate with fine particles, and pollutants that remain dissolved.

Table 12

Pollutant	Coarse Sediment and Trash	Pollutants that tend to associate with fine particles during treatment	Pollutants that tend to be dissolved following treatment
Sediment	X	X	
Nutrients		X	X
Heavy Metals		X	
Organic Compounds		X	
Trash & Debris	X		
Oxygen Demanding		X	
Bacteria		X	
Oil & Grease		X	
Pesticides		X	

A Treatment BMP must address runoff from developed areas. Please provide the postconstruction water quality values for the project. Label outfalls on the BMP map. The Water Quality peak rate of discharge flow (Q_{WQ}) and the Water Quality storage volume (V_{WQ}) is dependent on the type of treatment BMP selected for the project.

Outfall	Disturbed Area (acres)	Soils Type	QWQ (cfs)
Parcel 1	0.51	C	0.03
Parcel 2	0.58	C	0.04

Please check the box(s) that best describes the Treatment BMP(s) selected for this project.

Biofilters	
X	Vegetated swale
	Vegetated filter strip
	Stormwater Planter Box (open-bottomed)
	Stormwater Flow-Through Planter (sealed bottom)
	Bioretention Area
X	Rock Swale
Detention Basins	
	Extended/dry detention basin with grass/vegetated lining
	Extended/dry detention basin with impervious lining
Infiltration Basins	
	Infiltration basin
	Infiltration trench
	Dry well
	Permeable Paving
	Gravel
	Permeable asphalt
	Pervious concrete
	Unit pavers, ungrouted, set on sand or gravel
	Subsurface reservoir bed
Wet Ponds or Wetlands	
	Wet pond/basin (permanent pool)
	Constructed wetland
Filtration	
	Media filtration
	Sand filtration
Hydrodynamic Separator Systems	
	Swirl Concentrator
	Cyclone Separator
Trash Racks and Screens	

Include Treatment Datasheet as Attachment E. The datasheet should include the following:	COMPLETED	NO
1. Description of how treatment BMP was designed. Provide a description for each type of treatment BMP.	X	
2. Engineering calculations for the BMP(s)	X	

Please describe why the selected treatment BMP(s) was selected for this project. For projects utilizing a low performing BMP, please provide a detailed explanation and justification.

Biofilters- The vegetated swales and rock swales are a First Category maintenance mechanism. The Primary Pollutants of Concern are Sediment, Nutrients, Trash & Debris, Oxygen Demanding Substances, Oil & Grease, Bacteria and Pesticides. The combination of these two swale systems will be moderately to highly efficient in removing all the pollutants of concern.

MAINTENANCE

Please check the box that best describes the maintenance mechanism(s) for this project.

CATEGORY	SELECTED	
	YES	NO
First	X	
Second[1]		X
Third[1]		X
Fourth		X

Note:

1. Projects in Category 2 or 3 may choose to establish or be included in a Stormwater Maintenance Assessment District for the long-term maintenance of treatment BMPs.

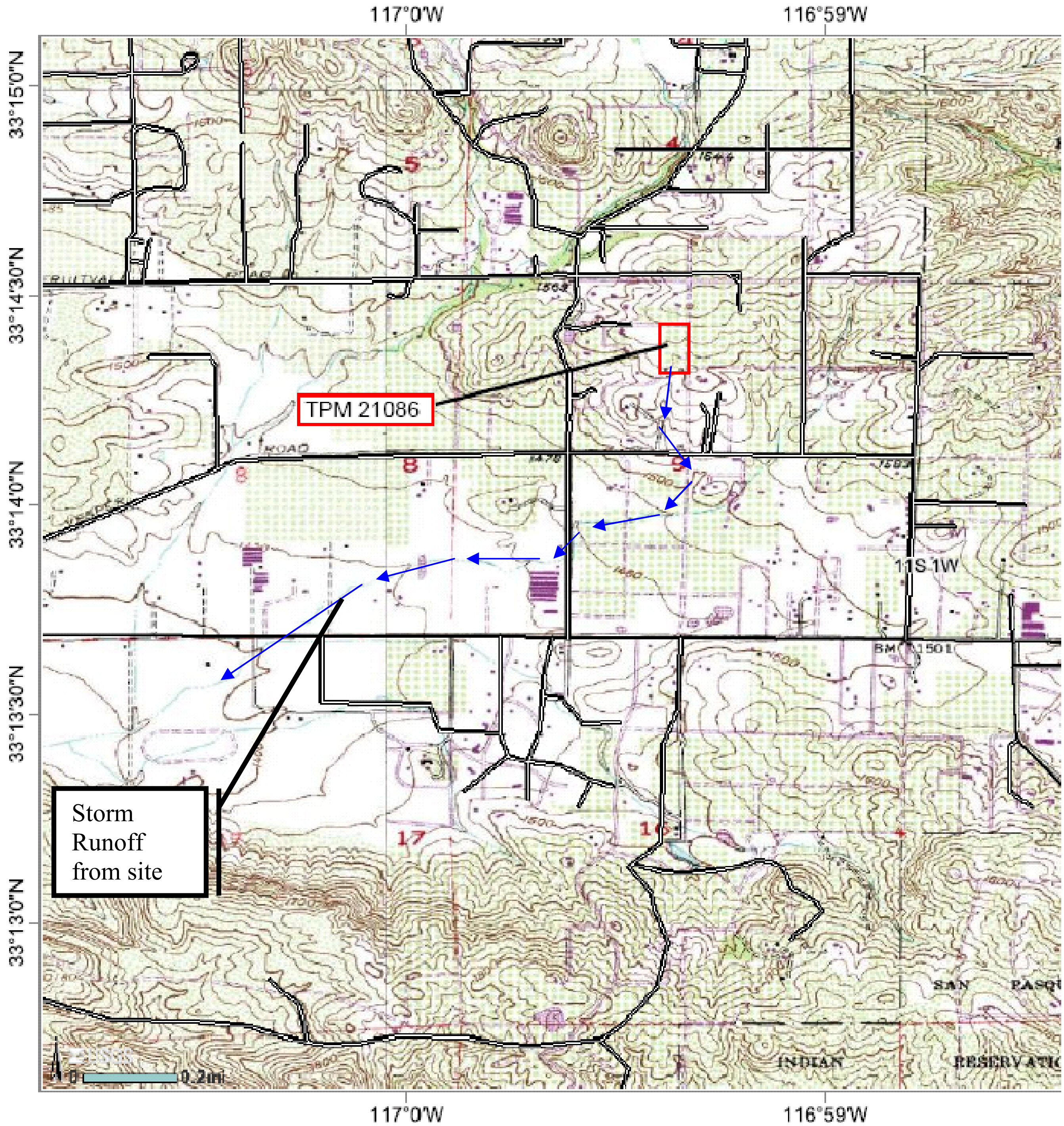
ATTACHMENTS

Please include the following attachments.

ATTACHMENT		COMPLETED	N/A
A	Project Location Map	✓	
B	Site Map	✓	
C	Relevant Monitoring Data	✓	
D	LID & Treatment BMP Location Map	✓	
E	Treatment BMP Datasheets	✓	
F	Operation and Maintenance Program for Treatment BMPs	✓	
G	Fiscal Resources	✓	
I	Engineer's Certification Sheet	✓	
J	Addendum	✓	

ATTACHMENT A

LOCATION MAP



A T T A C H M E N T B

PROJECT SITE MAP

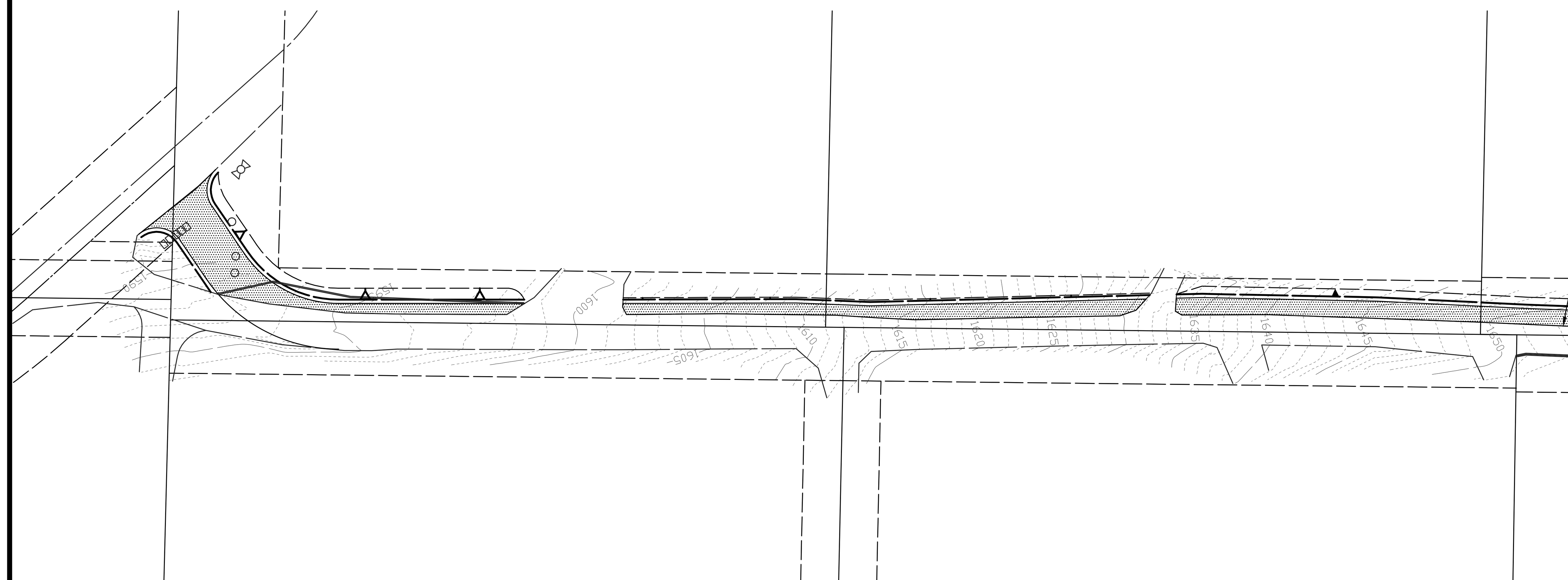
(See Attached Preliminary Grading Plan for TPM 21086 in following Folder)

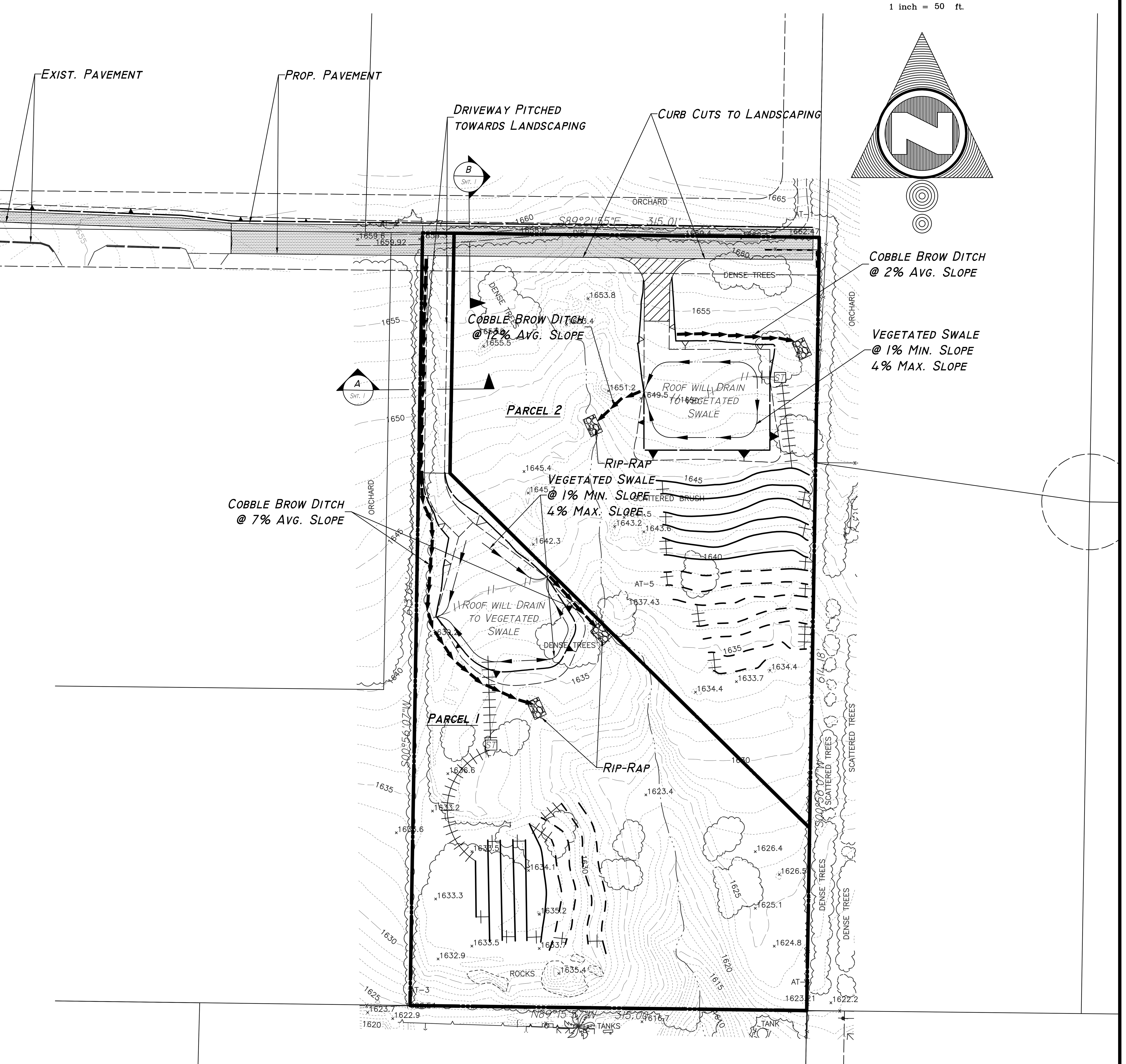
SWMP: LID & TREATMENT BMP LOCATION MAP - TPM 21086

GRAPHIC SCALE

50 0 25 50 100 200

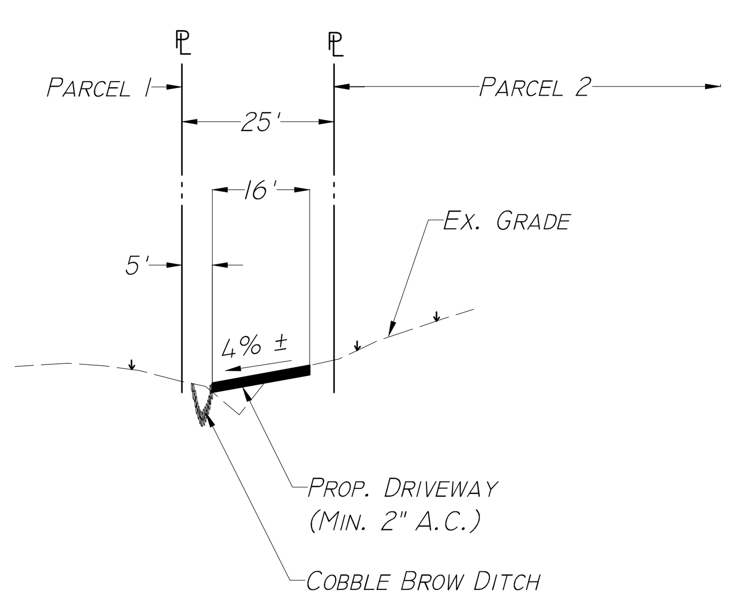
(IN FEET)
1 inch = 50 ft.



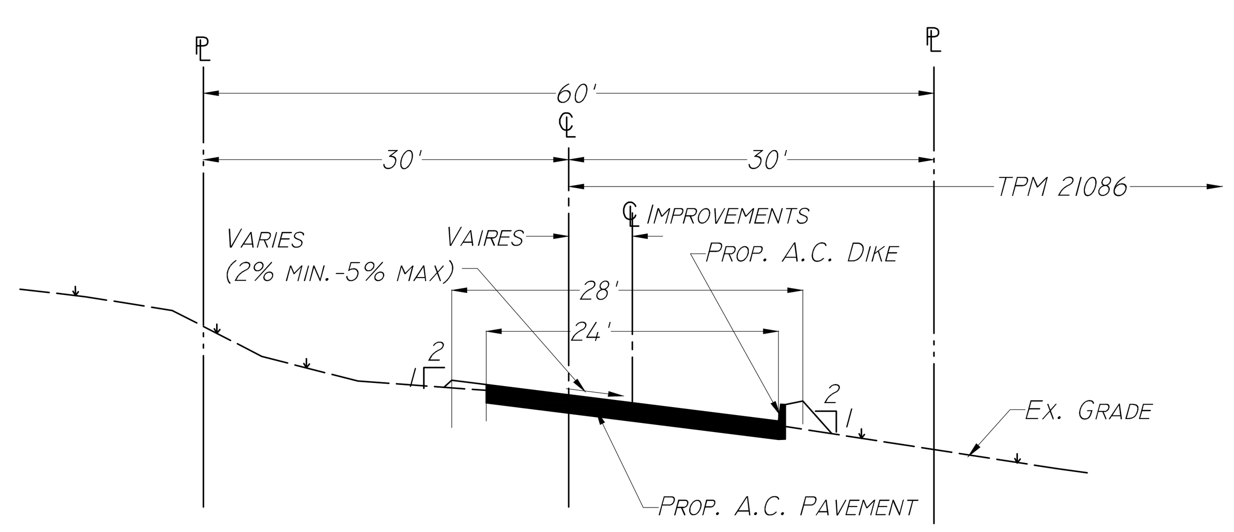


Legend

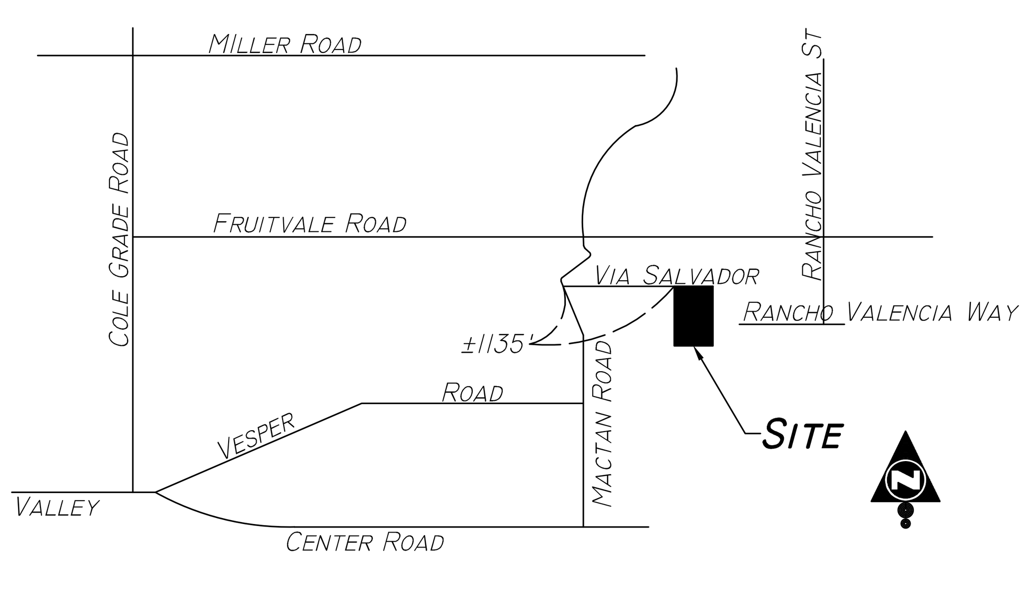
Description:	Symbol
Property Line	
Easement Line	
Slope Bank (2:1 Max cut and fill)	CUT FILL
Daylight Line	CUT FILL
Proposed Grade	3.2%
Spot Elevation	332.0
Exist. Contours	300
Cobble Brow Ditch	
Rip-Rap Energy Dissipator	



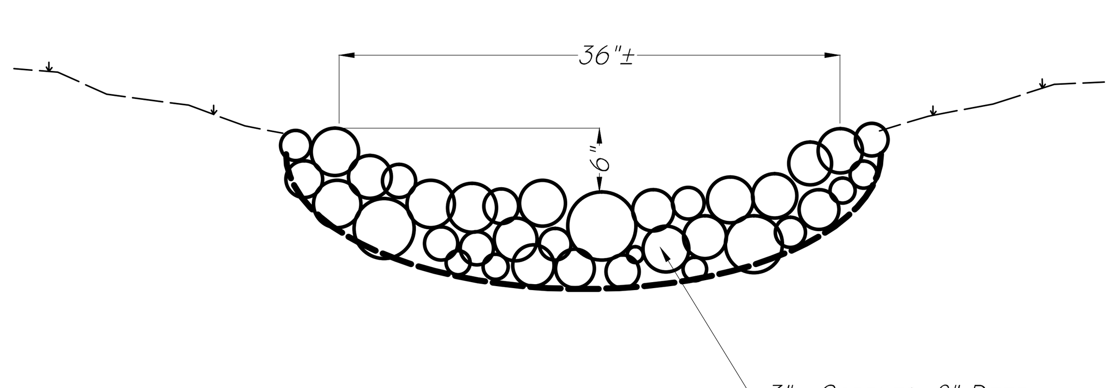
Section A
Not to Scale



Section B
Via Salvador
Not to Scale



Vicinity Map
N.T.S.



Cobble Brow Ditch
Not to Scale

MLB
Engineering
Professional Civil Engineers and Land Surveyors
404 South Live Oak Park Road, Fallbrook, CA 92028
Phone 760 731-6603 FAX 760 897-2165 E-Mail: MBenesh@MLBEngineering.com

No.	Description	Date
2	Response to County Letter Dated 10/17/2008	1SEP2009

Revisions

ATTACHMENT C

RELEVANT MONITORING DATA

No WATER QUALITY MONITORING DATA IS AVAILABLE.

ATTACHMENT D

LID AND TREATMENT BMP LOCATION MAP

(See Attached Map)

ATTACHMENT E

TREATMENT BMP DATASHEET

(See Attached Sheet Set)

Design Procedure Form for Design Flow

Uniform Intensity Design Flow

Designer:	
Company:	MLB Engineering
Date:	7/21/2009
Project:	Via Salvador
Location:	Parcel 1

1. Determine Impervious Percentage			
a. Determine total tributary area	A_{total} = 0.50	acres	***(1)***
b. Determine Impervious %	i = 34	%	***(2)***
2. Determine Runoff Coefficient Values Use **Table 4** and impervious % found in step 1			
a. A Soil Runoff Coefficient	C_a =		***(3)***
b. B Soil Runoff Coefficient	C_b =		***(4)***
c. C Soil Runoff Coefficient	C_c = 0.46		***(5)***
d. D Soil Runoff Coefficient	C_d =		***(6)***
3. Determine the Area decimal fraction of each soil type in tributary area			
a. Area of A Soil / ***(1)*** =	A_a =		***(7)***
b. Area of B Soil / ***(1)*** =	A_b =		***(8)***
c. Area of C Soil / ***(1)*** =	A_c = 0.50/0.50		***(9)***
d. Area of D Soil / ***(1)*** =	A_d =		***(10)***
4. Determine Runoff Coefficient			
a. C = ***(3)***x***(7)*** + ***(4)***x***(8)*** + ***(5)***x***(9)*** + ***(6)***x***(10)*** **=**	C = 0.23		***(11)***
5. Determine BMP Design flow			
a. Q_{BMP} = C x I x A = ***(11)*** x 0.2 x ***(1)***	Q_{BMP} = 0.023	$\frac{ft^3}{s}$	***(12)***

Worksheet 2

Design Procedure Form for Design Flow

Uniform Intensity Design Flow

Designer:	
Company:	MLB Engineering
Date:	7/21/2009
Project:	Via Salvador
Location:	Parcel 2

1. Determine Impervious Percentage			
a. Determine total tributary area	A_{total} = 0.58	acres	***(1)***
b. Determine Impervious %	i = 50	%	***(2)***
2. Determine Runoff Coefficient Values Use **Table 4** and impervious % found in step 1			
a. A Soil Runoff Coefficient	C_a =		***(3)***
b. B Soil Runoff Coefficient	C_b =		***(4)***
c. C Soil Runoff Coefficient	C_c = 0.56		***(5)***
d. D Soil Runoff Coefficient	C_d =		***(6)***
3. Determine the Area decimal fraction of each soil type in tributary area			
a. Area of A Soil / ***(1)*** =	A_a =		***(7)***
b. Area of B Soil / ***(1)*** =	A_b =		***(8)***
c. Area of C Soil / ***(1)*** =	A_c = 0.58/0.58		***(9)***
d. Area of D Soil / ***(1)*** =	A_d =		***(10)***
4. Determine Runoff Coefficient			
a. C = ***(3)***x***(7)*** + ***(4)***x***(8)*** + ***(5)***x***(9)*** + ***(6)***x***(10)*** **=**	C = 0.33		***(11)***
5. Determine BMP Design flow			
a. Q_{BMP} = C x I x A = ***(11)*** x 0.2 x ***(1)***	Q_{BMP} = 0.038	$\frac{ft^3}{s}$	***(12)***

Table 4. Runoff Coefficients for an Intensity = 0.2 $^{in}/_{hr}$ for Urban Soil Types*

Impervious %	A Soil RI =32	B Soil RI =56	C Soil RI =69	D Soil RI =75
0 (Natural)	0.06	0.14	0.23	0.28
5	0.10	0.18	0.26	0.31
10	0.14	0.22	0.29	0.34
15	0.19	0.26	0.33	0.37
20 (1-Acre)	0.23	0.30	0.36	0.40
25	0.27	0.33	0.39	0.43
30	0.31	0.37	0.43	0.47
35	0.35	0.41	0.46	0.50
40 (1/2-Acre)	0.40	0.45	0.50	0.53
45	0.44	0.48	0.53	0.56
50 (1/4-Acre)	0.48	0.52	0.56	0.59
55	0.52	0.56	0.60	0.62
60	0.56	0.60	0.63	0.65
65 (Condominiums)	0.61	0.64	0.66	0.68
70	0.65	0.67	0.70	0.71
75 (Mobilehomes)	0.69	0.71	0.73	0.74
80 (Apartments)	0.73	0.75	0.77	0.78
85	0.77	0.79	0.80	0.81
90 (Commercial)	0.82	0.82	0.83	0.84
95	0.86	0.86	0.87	0.87
100	0.90	0.90	0.90	0.90

*Complete District's standards can be found in the Riverside County Flood Control Hydrology Manual

Grassed Swales

General

A Grass swale is a wide, shallow densely vegetated channel that treats stormwater runoff as it is slowly conveyed into a downstream system. These swales have very shallow slopes in order to allow maximum contact time with the vegetation. The depth of water of the design flow should be less than the height of the vegetation. Contact with vegetation improves water quality by plant uptake of pollutants, removal of sediment, and an increase in infiltration. Overall the effectiveness of a grass swale is limited and it is recommended that they are used in combination with other BMPs.

This BMP is not appropriate for industrial sites or locations where spills occur. Important factors to consider when using this BMP include: natural channelization should be avoided to maintain this BMP's effectiveness, large areas must be divided and treated with multiple swales, thick cover is required to function properly, impractical for steep topography, and not effective with high flow velocities.

Grass Swale Design Criteria:

Design Parameter	Unit	Design Criteria
Design Flow	cfs	Q_{BMP}
Minimum bottom width	ft	2 ft [2]
Maximum channel side slope	H:V	3:1 [2]
Minimum slope in flow direction	%	0.2 (provide underdrains for slopes < 0.5) [1]
Maximum slope in flow direction	%	2.0 (provide grade-control checks for slopes >2.0) [1]
Maximum flow velocity	ft/sec	1.0 (based on Manning n = 0.20) [1]
Maximum depth of flow	inches	3 to 5 (1 inch below top of grass) [1]
Minimum contact time	minutes	7 [1]
Minimum length	ft	Sufficient length to provide minimum contact time [1]
Vegetation	-	Turf grass or approved equal [1]
Grass height	inches	4 to 6 (mow to maintain height) [1]

1 Ventura County's Technical Guidance Manual for Stormwater Quality Control Measures
2 City of Modesto's Guidance Manual for New Development Stormwater Quality Control Measures
3 CA Stormwater BMP Handbook for New Development and Significant Redevelopment
4 Riverside County DAMP Supplement A Attachment

Grass Swale Design Procedure

1. Design Flow
   Use Worksheet 2 - Design Procedure Form for Design Flow Rate, Q_{BMP}.

2. Swale Geometry
   a. Determine bottom width of swale (must be at least 2 feet).
   b. Determine side slopes (must not be steeper than 3:1; flatter is preferred).
   c. Determine flow direction slope (must be between 0.2% and 2%; provide underdrains for slopes less than 0.5% and provide grade control checks for slopes greater than 2.0%

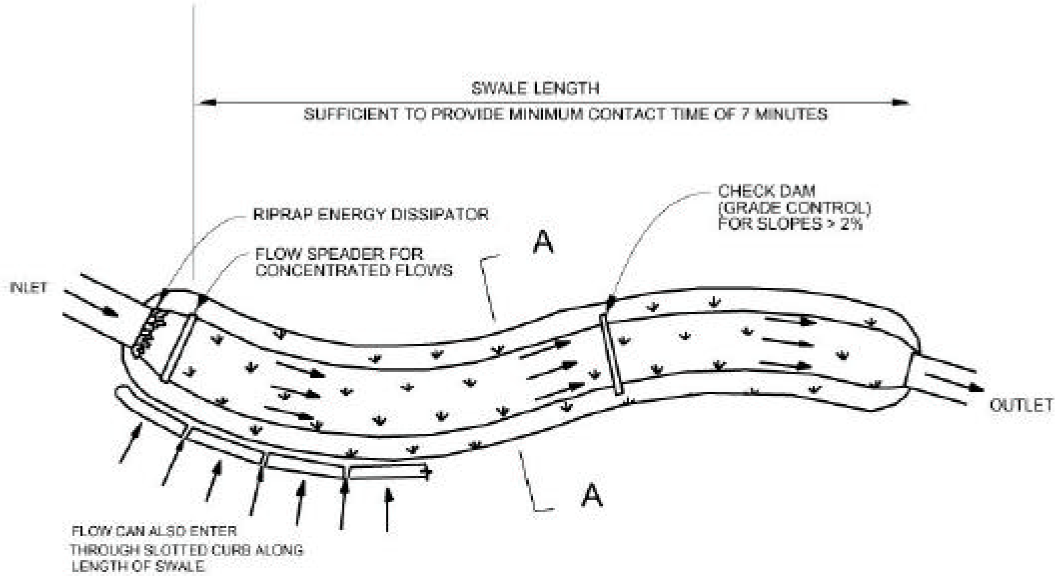
3. Flow Velocity
   Maximum flow velocity should not exceed 1.0 ft/sec based on a Mannings n = 0.20

4. Flow Depth
   Maximum depth of flow should not exceed 3 to 5 inches based on a Manning n = 0.20

5. Swale Length
   Provide length in the flow direction sufficient to yield a minimum contact time of 7 minutes.
   L = (7 min) x (flow velocity ft/s) x (60 sec/min)

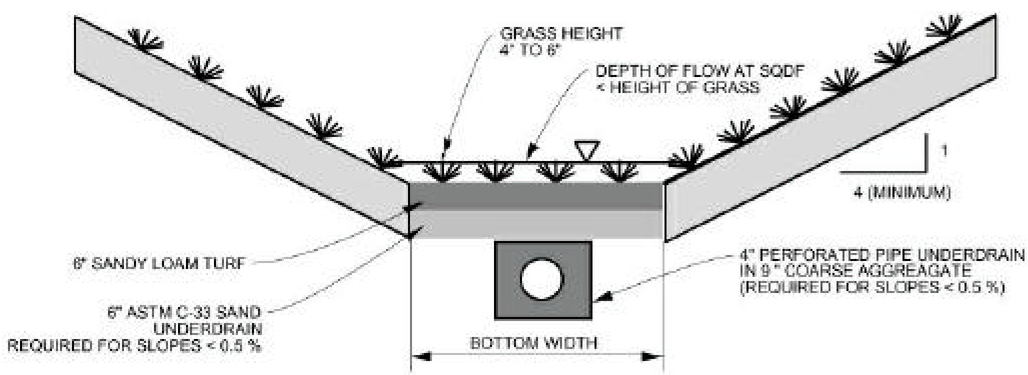
6. Vegetation
   Provide irrigated perennial turf grass to yield full, dense cover. Mow to maintain height of 4 to 6 inches.

7. Provide sufficient flow depth for flood event flows to avoid flooding of critical areas or structures.



TRAPEZOIDAL GRASS SWALE PLAN

NOT TO SCALE



TRAPEZOIDAL GRASS SWALE SECTION

NOT TO SCALE

Design Procedure Form for Grassed Swale

Designer: MLB Engineering
Company: MLB Engineering
Date: 7/21/09
Project: Via Salvador - TPM 21086
Location: Parcel 1

1. Determine Design Flow (Use Worksheet 2)	Q_{BMP} = 0.023 cfs
2. Swale Geometry a. Swale bottom width (b) b. Side slope (z) c. Flow direction slope (s)	 b = 2 ft z = 20% s = 7 avg %
3. Design flow velocity (Manning n = 0.2)	v = 0.24 ft/s
4. Depth of flow (D)	D = 0.05 ft
5. Design Length (L) L = (7 min) x (flow velocity, ft/sec) x 60	L = 101 ft
6. Vegetation (describe)	Grass or Cobbles
8. Outflow Collection (check type used or describe "other")	____ Grated Inlet' 0.5(Infiltration Trench ____ Underdrain X Other Natural Drainage

Notes:
Biofilter Swale exceeds 400 feet in length.

Design Procedure Form for Grassed Swale

Designer: MLB Engineering
Company: MLB Engineering
Date: 7/21/2009
Project: Via Salvador
Location: Parcel 2

1. Determine Design Flow (Use Worksheet 2)	Q_{BMP} = 0.038 cfs
2. Swale Geometry a. Swale bottom width (b) b. Side slope (z) c. Flow direction slope (s)	 b = 2 ft z = 20% s = 5 avg %
3. Design flow velocity (Manning n = 0.2)	v = 0.25 ft/s
4. Depth of flow (D)	D = 0.07 ft
5. Design Length (L) L = (7 min) x (flow velocity, ft/sec) x 60	L = 105 ft
6. Vegetation (describe)	Grass or Cobbles
8. Outflow Collection (check type used or describe "other")	___ Grated Inlet' 0.5(Infiltration Trench ___ Underdrain X Other Natural Drainage

Notes:
Biofilter swale exceeds 150 feet in length

Design Considerations

- Tributary Area
- Area Required
- Slope
- Water Availability

Description

Vegetated swales are open, shallow channels with vegetation covering the side slopes and bottom that collect and slowly convey runoff flow to downstream discharge points. They are designed to treat runoff through filtering by the vegetation in the channel, filtering through a subsoil matrix, and/or infiltration into the underlying soils. Swales can be natural or manmade. They trap particulate pollutants (suspended solids and trace metals), promote infiltration, and reduce the flow velocity of stormwater runoff. Vegetated swales can serve as part of a stormwater drainage system and can replace curbs, gutters and storm sewer systems.

California Experience

Caltrans constructed and monitored six vegetated swales in southern California. These swales were generally effective in reducing the volume and mass of pollutants in runoff. Even in the areas where the annual rainfall was only about 10 inches/yr, the vegetation did not require additional irrigation. One factor that strongly affected performance was the presence of large numbers of gophers at most of the sites. The gophers created earthen mounds, destroyed vegetation, and generally reduced the effectiveness of the controls for TSS reduction.

Advantages

- If properly designed, vegetated, and operated, swales can serve as an aesthetic, potentially inexpensive urban development or roadway drainage conveyance measure with significant collateral water quality benefits.

Targeted Constituents

☑	Sediment	▲
☑	Nutrients	●
☑	Trash	●
☑	Metals	▲
☑	Bacteria	●
☑	Oil and Grease	▲
☑	Organics	▲

Legend *(Removal Effectiveness)*

● Low ■ High

▲ Medium

CASQA
CALIFORNIA STORMWATER QUALITY ASSOCIATION

- Roadside ditches should be regarded as significant potential swale/buffer strip sites and should be utilized for this purpose whenever possible.

Limitations

- Can be difficult to avoid channelization.
- May not be appropriate for industrial sites or locations where spills may occur
- Grassed swales cannot treat a very large drainage area. Large areas may be divided and treated using multiple swales.
- A thick vegetative cover is needed for these practices to function properly.
- They are impractical in areas with steep topography.
- They are not effective and may even erode when flow velocities are high, if the grass cover is not properly maintained.
- In some places, their use is restricted by law: many local municipalities require curb and gutter systems in residential areas.
- Swales are mores susceptible to failure if not properly maintained than other treatment BMPs.

Design and Sizing Guidelines

- Flow rate based design determined by local requirements or sized so that 85% of the annual runoff volume is discharged at less than the design rainfall intensity.
- Swale should be designed so that the water level does not exceed 2/3rds the height of the grass or 4 inches, which ever is less, at the design treatment rate.
- Longitudinal slopes should not exceed 2.5%
- Trapezoidal channels are normally recommended but other configurations, such as parabolic, can also provide substantial water quality improvement and may be easier to mow than designs with sharp breaks in slope.
- Swales constructed in cut are preferred, or in fill areas that are far enough from an adjacent slope to minimize the potential for gopher damage. Do not use side slopes constructed of fill, which are prone to structural damage by gophers and other burrowing animals.
- A diverse selection of low growing, plants that thrive under the specific site, climatic, and watering conditions should be specified. Vegetation whose growing season corresponds to the wet season are preferred. Drought tolerant vegetation should be considered especially for swales that are not part of a regularly irrigated landscaped area.
- The width of the swale should be determined using Manning's Equation using a value of 0.25 for Manning's n.

Construction/Inspection Considerations

- Include directions in the specifications for use of appropriate fertilizer and soil amendments based on soil properties determined through testing and compared to the needs of the vegetation requirements.

- Install swales at the time of the year when there is a reasonable chance of successful establishment without irrigation; however, it is recognized that rainfall in a given year may not be sufficient and temporary irrigation may be used.

- If sod tiles must be used, they should be placed so that there are no gaps between the tiles; stagger the ends of the tiles to prevent the formation of channels along the swale or strip.

- Use a roller on the sod to ensure that no air pockets form between the sod and the soil.

- Where seeds are used, erosion controls will be necessary to protect seeds for at least 75 days after the first rainfall of the season.

Performance

The literature suggests that vegetated swales represent a practical and potentially effective technique for controlling urban runoff quality. While limited quantitative performance data exists for vegetated swales, it is known that check dams, slight slopes, permeable soils, dense grass cover, increased contact time, and small storm events all contribute to successful pollutant removal by the swale system. Factors decreasing the effectiveness of swales include compacted soils, short runoff contact time, large storm events, frozen ground, short grass heights, steep slopes, and high runoff velocities and discharge rates.

Conventional vegetated swale designs have achieved mixed results in removing particulate pollutants. A study performed by the Nationwide Urban Runoff Program (NURP) monitored three grass swales in the Washington, D.C., area and found no significant improvement in urban runoff quality for the pollutants analyzed. However, the weak performance of these swales was attributed to the high flow velocities in the swales, soil compaction, steep slopes, and short grass height.

Another project in Durham, NC, monitored the performance of a carefully designed artificial swale that received runoff from a commercial parking lot. The project tracked 11 storms and concluded that particulate concentrations of heavy metals (Cu, Pb, Zn, and Cd) were reduced by approximately 50 percent. However, the swale proved largely ineffective for removing soluble nutrients.

The effectiveness of vegetated swales can be enhanced by adding check dams at approximately 17 meter (50 foot) increments along their length (See Figure 1). These dams maximize the retention time within the swale, decrease flow velocities, and promote particulate settling. Finally, the incorporation of vegetated filter strips parallel to the top of the channel banks can help to treat sheet flows entering the swale.

Only 9 studies have been conducted on all grassed channels designed for water quality (Table 1). The data suggest relatively high removal rates for some pollutants, but negative removals for some bacteria, and fair performance for phosphorus.

Table 1 Grassed swale pollutant removal efficiency data							
Removal Efficiencies (% Removal)							
Study	**TSS**	**TP**	**TN**	**NO_3**	**Metals**	**Bacteria**	**Type**
Caltrans 2002	77	8	67	66	83-90	-33	dry swales
Goldberg 1993	67.8	4.5	-	31.4	42–62	-100	grassed channel
Seattle Metro and Washington Department of Ecology 1992	60	45	-	-25	2–16	-25	grassed channel
Seattle Metro and Washington Department of Ecology, 1992	83	29	-	-25	46–73	-25	grassed channel
Wang et al., 1981	80	-	-	-	70–80	-	dry swale
Dorman et al., 1989	98	18	-	45	37–81	-	dry swale
Harper, 1988	87	83	84	80	88–90	-	dry swale
Kercher et al., 1983	99	99	99	99	99	-	dry swale
Harper, 1988.	81	17	40	52	37–69	-	wet swale
Koon, 1995	67	39	-	9	-35 to 6	-	wet swale

While it is difficult to distinguish between different designs based on the small amount of available data, grassed channels generally have poorer removal rates than wet and dry swales, although some swales appear to export soluble phosphorus (Harper, 1988; Koon, 1995). It is not clear why swales export bacteria. One explanation is that bacteria thrive in the warm swale soils.

Siting Criteria

The suitability of a swale at a site will depend on land use, size of the area serviced, soil type, slope, imperviousness of the contributing watershed, and dimensions and slope of the swale system (Schueler et al., 1992). In general, swales can be used to serve areas of less than 10 acres, with slopes no greater than 5 %. Use of natural topographic lows is encouraged and natural drainage courses should be regarded as significant local resources to be kept in use (Young et al., 1996).

Selection Criteria (NCTCOG, 1993)

- Comparable performance to wet basins
- Limited to treating a few acres
- Availability of water during dry periods to maintain vegetation
- Sufficient available land area

Research in the Austin area indicates that vegetated controls are effective at removing pollutants even when dormant. Therefore, irrigation is not required to maintain growth during dry periods, but may be necessary only to prevent the vegetation from dying.

The topography of the site should permit the design of a channel with appropriate slope and cross-sectional area. Site topography may also dictate a need for additional structural controls. Recommendations for longitudinal slopes range between 2 and 6 percent. Flatter slopes can be used, if sufficient to provide adequate conveyance. Steep slopes increase flow velocity, decrease detention time, and may require energy dissipating and grade check. Steep slopes also can be managed using a series of check dams to terrace the swale and reduce the slope to within acceptable limits. The use of check dams with swales also promotes infiltration.

Additional Design Guidelines

Most of the design guidelines adopted for swale design specify a minimum hydraulic residence time of 9 minutes. This criterion is based on the results of a single study conducted in Seattle, Washington (Seattle Metro and Washington Department of Ecology, 1992), and is not well supported. Analysis of the data collected in that study indicates that pollutant removal at a residence time of 5 minutes was not significantly different, although there is more variability in that data. Therefore, additional research in the design criteria for swales is needed. Substantial pollutant removal has also been observed for vegetated controls designed solely for conveyance (Barrett et al, 1998); consequently, some flexibility in the design is warranted.

Many design guidelines recommend that grass be frequently mowed to maintain dense coverage near the ground surface. Recent research (Colwell et al., 2000) has shown mowing frequency or grass height has little or no effect on pollutant removal.

Summary of Design Recommendations

1) The swale should have a length that provides a minimum hydraulic residence time of at least 10 minutes. The maximum bottom width should not exceed 10 feet unless a dividing berm is provided. The depth of flow should not exceed 2/3rds the height of the grass at the peak of the water quality design storm intensity. The channel slope should not exceed 2.5%.

2) A design grass height of 6 inches is recommended.

3) Regardless of the recommended detention time, the swale should be not less than 100 feet in length.

4) The width of the swale should be determined using Manning's Equation, at the peak of the design storm, using a Manning's n of 0.25.

5) The swale can be sized as both a treatment facility for the design storm and as a conveyance system to pass the peak hydraulic flows of the 100-year storm if it is located "on-line." The side slopes should be no steeper than 3:1 (H:V).

6) Roadside ditches should be regarded as significant potential swale/buffer strip sites and should be utilized for this purpose whenever possible. If flow is to be introduced through curb cuts, place pavement slightly above the elevation of the vegetated areas. Curb cuts should be at least 12 inches wide to prevent clogging.

7) Swales must be vegetated in order to provide adequate treatment of runoff. It is important to maximize water contact with vegetation and the soil surface. For general purposes, select fine, close-growing, water-resistant grasses. If possible, divert runoff (other than necessary irrigation) during the period of vegetation

establishment. Where runoff diversion is not possible, cover graded and seeded areas with suitable erosion control materials.

Maintenance

The useful life of a vegetated swale system is directly proportional to its maintenance frequency. If properly designed and regularly maintained, vegetated swales can last indefinitely. The maintenance objectives for vegetated swale systems include keeping up the hydraulic and removal efficiency of the channel and maintaining a dense, healthy grass cover.

Maintenance activities should include periodic mowing (with grass never cut shorter than the design flow depth), weed control, watering during drought conditions, reseeding of bare areas, and clearing of debris and blockages. Cuttings should be removed from the channel and disposed in a local composting facility. Accumulated sediment should also be removed manually to avoid concentrated flows in the swale. The application of fertilizers and pesticides should be minimal.

Another aspect of a good maintenance plan is repairing damaged areas within a channel. For example, if the channel develops ruts or holes, it should be repaired utilizing a suitable soil that is properly tamped and seeded. The grass cover should be thick; if it is not, reseed as necessary. Any standing water removed during the maintenance operation must be disposed to a sanitary sewer at an approved discharge location. Residuals (e.g., silt, grass cuttings) must be disposed in accordance with local or State requirements. Maintenance of grassed swales mostly involves maintenance of the grass or wetland plant cover. Typical maintenance activities are summarized below:

- Inspect swales at least twice annually for erosion, damage to vegetation, and sediment and debris accumulation preferably at the end of the wet season to schedule summer maintenance and before major fall runoff to be sure the swale is ready for winter. However, additional inspection after periods of heavy runoff is desirable. The swale should be checked for debris and litter, and areas of sediment accumulation.

- Grass height and mowing frequency may not have a large impact on pollutant removal. Consequently, mowing may only be necessary once or twice a year for safety or aesthetics or to suppress weeds and woody vegetation.

- Trash tends to accumulate in swale areas, particularly along highways. The need for litter removal is determined through periodic inspection, but litter should always be removed prior to mowing.

- Sediment accumulating near culverts and in channels should be removed when it builds up to 75 mm (3 in.) at any spot, or covers vegetation.

- Regularly inspect swales for pools of standing water. Swales can become a nuisance due to mosquito breeding in standing water if obstructions develop (e.g. debris accumulation, invasive vegetation) and/or if proper drainage slopes are not implemented and maintained.

Cost

Construction Cost

Little data is available to estimate the difference in cost between various swale designs. One study (SWRPC, 1991) estimated the construction cost of grassed channels at approximately \$0.25 per ft^2. This price does not include design costs or contingencies. Brown and Schueler (1997) estimate these costs at approximately 32 percent of construction costs for most stormwater management practices. For swales, however, these costs would probably be significantly higher since the construction costs are so low compared with other practices. A more realistic estimate would be a total cost of approximately \$0.50 per ft^2, which compares favorably with other stormwater management practices.

Table 2 Swale Cost Estimate (SEWRPC, 1991)

Component	Unit	Extent	Unit Cost			Total Cost		
			Low	Moderate	High	Low	Moderate	High
Mobilization / Demobilization-Light	Swale	1	$107	$274	$441	$107	$274	$441
Site Preparation								
Clearing[b]...............	Acre	0.5	$2,200	$3,800	$5,400	$1,100	$1,900	$2,700
Grubbing[c].............	Acre	0.25	$3,800	$5,200	$6,600	$950	$1,300	$1,650
General Excavation[d]...........	Yd^3	372	$2.10	$3.70	$5.30	$781	$1,376	$1,972
Level and Till[e]........	Yd^2	1,210	$0.20	$0.35	$0.50	$242	$424	$605
Sites Development								
Salvaged Topsoil Seed, and Mulch[f]..	Yd^2	1,210	$0.40	$1.00	$1.60	$484	$1,210	$1,936
Sod[g].....................	Yd^2	1,210	$1.20	$2.40	$3.60	$1,452	$2,904	$4,356
Subtotal	--	--	--	--	--	$5,116	$9,388	$13,660
Contingencies	Swale	1	25%	25%	25%	$1,279	$2,347	$3,415
Total	--	--	--	--	--	$6,395	$11,735	$17,075

Source: (SEWRPC, 1991)

Note: Mobilization/demobilization refers to the organization and planning involved in establishing a vegetative swale.

[a] Swale has a bottom width of 1.0 foot, a top width of 10 feet with 1:3 side slopes, and a 1,000-foot length.

[b] Area cleared = (top width + 10 feet) x swale length.

[c] Area grubbed = (top width x swale length).

[d] Volume excavated = (0.67 x top width x swale depth) x swale length (parabolic cross-section).

[e] Area tilled = $\left(\text{top width} + \frac{8(\text{swale depth}^2)}{3(\text{top width})}\right)$ x swale length (parabolic cross-section).

[f] Area seeded = area cleared x 0.5.

[g] Area sodded = area cleared x 0.5.

Table 3 Estimated Maintenance Costs (SEWRPC, 1991)

Component	Unit Cost	Swale Size (Depth and Top Width)		Comment
		1.5 Foot Depth, One-Foot Bottom Width, 10-Foot Top Width	3-Foot Depth, 3-Foot Bottom Width, 21-Foot Top Width	
Lawn Mowing	\$0.85 / 1,000 ft^2/ mowing	\$0.14 / linear foot	\$0.21 / linear foot	Lawn maintenance area=(top width + 10 feet) x length. Mow eight times per year
General Lawn Care	\$9.00 / 1,000 ft^2/ year	\$0.18 / linear foot	\$0.28 / linear foot	Lawn maintenance area = (top width + 10 feet) x length
Swale Debris and Litter Removal	\$0.10 / linear foot / year	\$0.10 / linear foot	\$0.10 / linear foot	–
Grass Reseeding with Mulch and Fertilizer	\$0.30 / yd^2	\$0.01 / linear foot	\$0.01 / linear foot	Area revegetated equals 1% of lawn maintenance area per year
Program Administration and Swale Inspection	\$0.15 / linear foot / year, plus \$25 / inspection	\$0.15 / linear foot	\$0.15 / linear foot	Inspect four times per year
Total	--	**\$0.58 / linear foot**	**\$ 0.75 / linear foot**	--

Maintenance Cost

Caltrans (2002) estimated the expected annual maintenance cost for a swale with a tributary area of approximately 2 ha at approximately $2,700. Since almost all maintenance consists of mowing, the cost is fundamentally a function of the mowing frequency. Unit costs developed by SEWRPC are shown in Table 3. In many cases vegetated channels would be used to convey runoff and would require periodic mowing as well, so there may be little additional cost for the water quality component. Since essentially all the activities are related to vegetation management, no special training is required for maintenance personnel.

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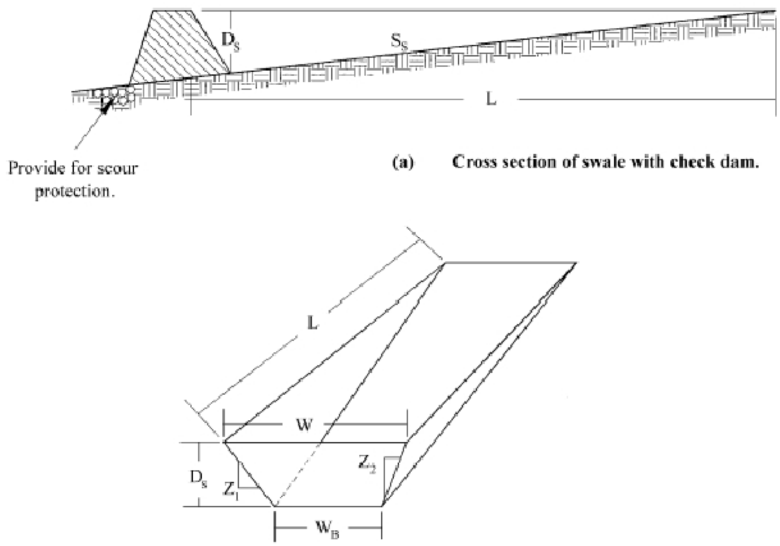

(a) Cross section of swale with check dam.

(b) Dimensional view of swale impoundment area.

Notation:

L = Length of swale impoundment area per check dam (ft)
D_S = Depth of check dam (ft)
S_S = Bottom slpe of swale (ft/ft)
W = Top width of check dam (ft)
W_B = Bottom width of check dam (ft)
$Z_{1\&2}$ = Ratio of horizontal to vertical change in swale side slope (ft/ft)

A T T A C H M E N T   F

OPERATION AND MAINTENANCE PROGRAM FOR TREATMENT BMP

The operation and maintenance requirements for each type of BMP is as follows:

Section 1.01 *Vegetated Swales or Vegetated Strips*

The operational and maintenance needs of a Swale or Strip are:

- Vegetation management to maintain adequate hydraulic functioning and to limit habitat for disease-carrying animals.
- Animal and vector control.
- Periodic sediment removal to optimize performance.
- Trash, debris, grass trimmings, tree pruning, and leaf collection and removal to prevent obstruction of a Swale or Strip and monitoring equipment.
- Removal of standing water, which may contribute to the development of aquatic plant communities or mosquito breeding areas.
- Preventive maintenance on sampling, flow measurement, and associated BMP equipment and structures.
- Erosion and structural maintenance to prevent the loss of soil and maintain the performance of the Swale or Strip.

1.01.1 *Inspection Frequency*

The facility will be inspected and inspection visits will be completely documented:

- Once a month at a minimum.
- After every large storm (after every storm monitored or those storms with more than 0.50 inch of precipitation.)
- On a weekly basis during extended periods of wet weather.

1.01.2 *Aesthetic and Functional Maintenance*

Aesthetic maintenance is important for public acceptance of stormwater facilities. Functional maintenance is important for performance and safety reasons.
Both forms of maintenance will be combined into an overall Stormwater Management System Maintenance.

1.01.2(i) Aesthetic Maintenance

The following activities will be included in the aesthetic maintenance program:

- Grass Trimming. Trimming of grass will be done on the Swale or Strip, around fences, at the inlet and outlet structures, and sampling structures.
- Weed Control. Weeds will be removed through mechanical means. Herbicide will not be used because these chemicals may impact the water quality monitoring.

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1.01.2(ii) Functional Maintenance

Functional maintenance has two components:

1. Preventive maintenance
2. Corrective maintenance

1.01.2 (ii)(a) Preventive Maintenance

Preventive maintenance activities to be instituted at a Swale or Strip are:

- Grass Mowing. Vegetation seed mix within the Swale or Strip is designed to be kept short to maintain adequate hydraulic functioning and to limit the development of faunal habitats.
- Trash and Debris. During each inspection and maintenance visit to the site, debris and trash removal will be conducted to reduce the potential for inlet and outlet structures and other components from becoming clogged and inoperable during storm events.
- Sediment Removal. Sediment accumulation, as part of the operation and maintenance program at a Swale, will be monitored once a month during the dry season, after every large storm (0.50 inch), and monthly during the wet season. Specifically, if sediment reaches a level at or near plant height, or could interfere with flow or operation, the sediment will be removed. If accumulation of debris or sediment is determined to be the cause of decline in design performance, prompt action (i.e., within ten working days) will be taken to restore the Swale or Strip to design performance standards. Actions will include using additional fill and vegetation and/or removing accumulated sediment to correct channeling or ponding. Characterization and Appropriate disposal of sediment will comply with applicable local, county, state, or federal requirements. The swale or stripwill be regraded, if the flow gradient has changed, and then replanted with sod.
- Removal of Standing Water. Standing water must be removed if it contributes to the development of aquatic plant communities or mosquito breeding areas.
- Mechanical and Electronic Components. Regularly scheduled maintenance will be performed on fences, gates, locks, and sampling and monitoring equipment in accordance with the manufacturers' recommendations. Electronic and mechanical components will be operated during each maintenance inspection to assure continued performance.
- Fertilization and Irrigation. The vegetation seed mix has been designed so that fertilization and irrigation is not necessary. Fertilizers and irrigation will not be used to maintain the vegetation.
- Elimination of Mosquito Breeding Habitats. The most effective mosquito control program is one that eliminates potential breeding habitats.

1.01.2 (ii)(b) Corrective Maintenance

Corrective maintenance is required on an emergency or non-routine basis to correct problems and to restore the intended operation and safe function of a Swale or Strip. Corrective maintenance activities include:

- Removal of Debris and Sediment. Sediment, debris, and trash, which impede the hydraulic functioning of a Swale and prevent vegetative growth, will be removed and properly disposed. Temporary arrangements will be made for handling the sediments until a permanent arrangement is made. Vegetation will be re-established after sediment removal.

- Structural Repairs. Once deemed necessary, repairs to structural components of a Swale or Strip and its inlet and outlet structures will be done within 10 working days. Qualified individuals (i.e., the designers or contractors) will conduct repairs where structural damage has occurred.
- Embankment and Slope Repairs. Once deemed necessary, damage to the embankments and slopes of Swales will be repaired within 10 working days).
- Erosion Repair. Where a reseeding program has been ineffective, or where other factors have created erosive conditions (i.e., pedestrian traffic, concentrated flow, etc.), corrective steps will be taken to prevent loss of soil and any subsequent danger to the performance of a Swale or Strip. There are a number of corrective actions than can be taken. These include erosion control blankets, rip-rap, sodding, or reduced flow through the area. Designers or contractors will be consulted to address erosion problems if the solution is not evident.
- Fence Repair. Repair of fences will be done within 30 days to maintain the security of the site.
- Elimination of Animal Burrows. Animal burrows will be filled and steps taken to remove the animals if burrowing problems continue to occur (filling and compacting). If the problem persists, vector control specialists will be consulted regarding removal steps. This consulting is necessary as the threat of rabies in some areas may necessitate the animals being destroyed rather than relocated. If the BMP performance is affected, abatement will begin. Otherwise, abatement will be performed annually in September.
- General Facility Maintenance. In addition to the above elements of corrective maintenance, general corrective maintenance will address the overall facility and its associated components. If corrective maintenance is being done to one component, other components will be inspected to see if maintenance is needed.

1.01.3 Maintenance Frequency

The maintenance indicator document, included as Appendix B, lists the schedule of maintenance activities to be implemented at a Swale or Strip.

- After every large storm (after every storm monitored or those storms with more than 0.50 inch of precipitation).
- On a weekly basis during extended periods of wet weather.
- On a monthly basis during the non-rainy season or periods of dry weather.

1.01.4 Debris and Sediment Disposal

Waste generated at Swales or Strips is ultimately the responsibility of the property owner. Disposal of sediment, debris, and trash will comply with applicable local, county, state, and federal waste control programs.

1.01.5 Estimated Annual Maintenance Costs

Based on Appendix H of the San Diego County SUSMP Manual the estimated annual cost for Bio-Filter strips and swales is $2970.

A T T A C H M E N T G

FISCAL RESOURCES

ATTACHMENT H

CERTIFICATION SHEET

This Stormwater Management Plan has been prepared under the direction of the following Registered Civil Engineer. The Registered Civil Engineer attests to the technical information contained herein and the engineering data upon which recommendations, conclusions, and decisions are based.

The combination of proposed construction and post-construction BMPs will reduce, to the maximum extent practicable, the expected pollutants and will not adversely impact the beneficial uses or water quality of the receiving waters.

____ ____________________

Michael L. Benesh, RCE 37893 Date
Reg. Expires 3/31/11

A T T A C H M E N T I

ADDENDUM